Butler University Botanical Studies

Volume 4 *Butler University Botanical Studies* Article 12

Keys to species and varieties of ferns and fern allies of northeastern North America

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Butler University Botanical Studies

(1929-1964)

Edited by

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The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana's vegetation in past decades. Authors were Butler faculty, current and former master's degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler's first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

During the years of the journal's publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor's degrees and 75 master's degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner , included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master's students who made active contributions to the fields of botany and ecology include Dwight. W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daubenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

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KEY TO SPECIES AND VARIETIES OF FERNS AND FERN ALLIES OF NORTHEASTERN NORTH AMERICA

By RAY C. FRIESNER

The publication of Broun's[1] "Index to North American Ferns" has filled a long-felt need for students of pteridophytes. The frequent changing of names of plants is not only confusing to students but annoying to teachers as well, when they must learn a new name every year and perhaps carry several names in their mind at once in order to meet the needs of students using different keys and manuals. Broun's book will go far toward stabilizing a recently vacillating field of taxonomy and is essential in every laboratory where pteridophytes are studied and taught.

With the matter of nomenclature and synonymy settled for a while, the next demand for teaching taxonomy of this group is a convenient manual and key for student use. No manual is available for all of the species and varieties occurring in northeastern North America but we have found Wherry's[2] "Guide to Eastern Ferns" most suited for our purposes. This excellent little manual contains no key. Consequently, it was necessary to construct our own key for student use.

The following key is aimed at enabling students to determine the species and varieties of pteridophytes given by Broun for northeastern North America (what is commonly thought of as the "Gray's Manual range"). It makes no claim to originality in the choice of differentiating characters and to the host of students in this field from whose published writings material has been taken, credit is here acknowledged. Following each name are given page references in Gray's Manual, 7ed. (G), Wherry's Manual (W), and other references when the plant is not to be found in either of these manuals.

In order that teachers may have this key available for student use, reprints of this paper are available at ten cents per copy and may be secured from the Botany Department of Butler University.

KEY

1. Plants floating on the surface of boggy waters..... 2
1. Plants not floating..... 3

[1]Broun, Maurice. Index to North American Ferns. Published by the author, Orleans, Mass. 1938.

[2]Wherry, Edgar T. Guide to Eastern Ferns. Science Press. 1937.

2. Leaves apparently 2-ranked, densely papillose on dorsal surface ..... *Salvinia natans* (L.) All. G 50

2. Leaves closely imbricated, glabrous on dorsal surface ..... *Azolla caroliniana* Willd. G 50; W 47

3. Plants twining or climbing .... *Lygodium palmatum* (Bernh.) Sw. G 46; W 43

3. Plants neither twining nor climbing 4

4. Plants very slender, filiform, tortuous .... *Schizea pusilla* Pursh. G 45; W 45

4. Plants neither filiform nor tortuous 5

5. Leaves 4-foliolate 6

5. Leaves reduced to mere vestigial scales whorled at the nodes of jointed stems (Equisetum) 152

5. Leaves very long and narrow, 3-20 cm long by 0.5-1 cm wide, very closely imbricated on a short corm-like stem (Isoetes) 166

5. Leaves very small, 2-10 mm long, very closely imbricated (Lycopodineae) 7

5. Leaves larger, broader, frond-like (common true ferns) .. 35

6. Leaflets glabrous; sporocarps 2-3; peduncle attached to petiole ..... *Marsilea quadrifolia* L. G 50; W 47

6. Leaflets hairy; sporocarps solitary; peduncle free from petiole ..... *Marsilea vestita* Hook. & Grv. G 50

7. Homosporous, i. e. spores and sporangia of one type only .. 8

7. Heterosporous, i. e. spores and sporangia obviously of two sizes 33

8. Spore-bearing leaves not aggregated into definite strobili or cones 9

8. Spore-bearing leaves aggregated into definite strobili .. 12

9. Leaves in alternating zones of longer and shorter lengths .. 10

9. Leaves uniform in length, i. e. not in alternating zones of longer and shorter lengths .... *Lycopodium selago* L. G 55; W 161

10. Leaves broadest near or above their middle 11

10. Leaves broadest at their bases .... *Lycopodium selago patens* (Beauv.) Desv. G 55; W 163 (*L. lucidulum porophilum* in Gray Man. 7ed.)

11. Leaves definitely serrate ..... *Lycopodium lucidulum* Mx. G 55; W 165

11. Leaves entire or only slightly serrate ..... *Lycopodium lucidulum occidentale* (Clute) Wilson. G 55; W 165 (Rhodora 34:170. *L. l. porophilum* in Gray Man. 7ed.)

12. Sporophylls, i. e. the leaves comprising the strobili, not conspicuously different in appearance from the vegetative leaves 13

12. Sporophylls yellowish and scale-like, very different in appearance from the vegetative leaves 17

13. Sporophylls 7-10 mm long 16

13. Sporophylls 5-6 mm long 14

14. Sporophylls deltoid, mostly entire 15

14. Sporophylls suddenly contracted above the base into a narrow subulate apex, more or less toothed near base .. *Lycopodium adpressum* (Chapm.) L. & U. W 183

15. Fertile branches 3-10 cm high ..... *Lycopodium inundatum* L. G 56; W 179

15. Fertile branches 1-3 dm high ..... *Lycopodium inundatum bigelovii* Tuckerm. G 56; W 179

16. Median sporophylls 0.75-1.25 mm wide at base, beset with 6-10 or more bristle-like teeth rather evenly distributed from the base upwards to beyond the middle.. *Lycopodium alopecuroides* L. G 55; W 181

16. Median sporophylls about 1.5 mm wide at base, beset with 4-6 marginal teeth or bristles clustered between the spore case and the middle of the sporophyll.... *Lycopodium inundatum robustum* R. J. Eaton. W 179; Rhodora 33: 202.

17. Leaves on the vegetative branches about uniform in length all the way around the stem, giving the branch as a whole a nearly cylindrical appearance (except for flattening due to pressing in the case of herbarium material) 18

17. Leaves on the vegetative branches longer on the sides than on the top and bottom of each branch, giving the branch a more or less flattish appearance 26

18. Free (i. e. unattached) portion of leaves 1-3 mm

long; leaves in 5 rows ..... *Lycopodium sitchense* Rupr. G 56

18. Free portion of leaves 4-8 mm long; leaves in more than 5 rows 19

19. Strobili sessile at the ends of leafy branches, i. e. not lifted above vegetative portions of stem on peduncles differing conspicuously from the vegetative branches 20

19. Strobili lifted above the vegetative parts by slender peduncles containing modified scale-like leaves 23

20. Erect stems dendroid, i. e. tree-like in their branching ..... *Lycopodium obscurum dendroideum* (Mx) D. C. Eaton. G 56; W 171

20. Erect stems simple, not at all dendroid 21

21. Leaves appressed ..... *Lycopodium annotinum pungens* Desv. G 56

21. Leaves spreading 22

22. Leaves lanceolate to oblanceolate, distinctly serrate, thin ..... *Lycopodium annotinum* L. G 56; W 167

22. Leaves linear or lance-attenuate, entire or slightly serrate, thickish ..... *Lycopodium annotinum acrifolium* Fern. Rhodora 17:124

23. Stroboli one per peduncle 24

23. Strobili two per peduncle 25

23. Strobili three or more per peduncle ..... *Lycopodium clavatum subremotum* Vict. Contr. Bot. Lab. Univ. Montreal 3:24. 1925

24. Peduncles 1-2.5 cm long ..... *Lycopodium clavatum monostachyum* Desv. G 56

24. Peduncles 3-15 cm long ..... *Lycopodium clavatum megastachyon* Fernald & Bissell. Rhodora 12:53

25. Strobili sessile on the peduncle ..... *Lycopodium clavatum* L. G 56; W 169

25. Strobili on short secondary peduncles (pedicels) ..... *Lycopodium clavotum laurentianum* Vict. Contr. Bot. Lab. Univ. Montreal 3:23. 1925

26. Strobili borne sessile at the ends of leafy branches.. ..... *Lycopodium obscurum* L. G 56; W 173

26. Strobili lifted above the leafy branches on definite peduncles 27

27. Peduncles arising direct from horizontal stems or rootstocks .....*Lycopodium carolinianum* L. G 56; W 185
27. Peduncles arising from tips of erect branches 28
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28. Free portion of lateral leaves not over 1/2 as long as the adnate portion 30
29. Peduncles 1.5-4 cm long .....
.....*Lycopodium sabinaefolium* Willd. G 56
29. Peduncles 6-7.6 cm long .....*Lycopodium sabinaefolium sharonense* Blake. Rhodora 20:60
30. Branches somewhat glaucous, bluish-green in color; branch plus adnate portion of leaves 1-1.5 mm wide; ventral median leaf reaching or over-lapping the next one above it .....
....*Lycopodium tristachyum* Pursh G 57; W 175
30. Branches not glaucous, yellowish-green in color; branch plus adnate portion of the leaves 1.8-4 mm wide; ventral median leaves much reduced 31
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32. Strobili on short pedicels; rootstock deep .....
.....*Lycopodium complanatum elongatum* Vict. Contr. Lab. Bot. Univ. Montreal 3:72. 1929
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33. Dorsal and ventral leaves shorter than the lateral.....
.....*Selaginella apoda* (L.) Spring. G 58; W 189
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..*Selaginella rupestris* (L.) Spring. G 57; W 187
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35. Not differentiated into separate vegetative and fertile fronds, or if so, they are not conspicuously different from each other 39
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36. Stipe of fertile frond not as above 37
37. Fertile frond 2-pinnate 38
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39. Individual fronds composed of both entirely vegetative and entirely fertile pinnae or subdivisions 40
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40. Vegetative segment of frond simple, i. e. not divided into separate pinnae 41
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divisions crowded and overlapping ....*Botrychium multifidum* (S. G. Gmel.) Rupr. (B. *ternatum rutaefolium* in Gray Man. 7ed.) G 49; W 19

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51. Vegetative segment 3-4-pinnate 60

52. Vegetative segment entire to 1-pinnate 53

52. Vegetative segment 2-pinnatifid to 2-pinnate..... 58

53. Veins of the pinnules radiating from the base and repeatedly forking; pinnules fan-shaped, all alike..... 54

53. Veins of the pinnules all forking from the base; pinnules roundish-obovate, dissimilar 56

54. Vegetative segment sessile or subsessile; ultimate subdivisions proximate or remote 55

54. Vegetative segment decidedly stalked; ultimate subdivisions remote .....*Botrychium lunaria onondagense* (Underw.) House. G 48

55. Vegetative segment inserted below the middle of the plant: ultimate subdivisions nearly circular .....
.....*Botrychium lunaria minganense* (Vict.) Dole. Mem. Torr. Bot. Cl. 19:67. 1938

55. Vegetative segment inserted at the middle; ultimate subdivisions comprising little over half-circles .....
.....*Botrychium lunaria* (L.) Sw. G 48

56. Plant stout and leathery; vegetative segment inseted at or below the middle of the plant; ultimate subdivisions proximate or overlapping .....
.....*Botrychium simplex* Hitchc. G 48; W 29

56. Plant lax and membranous; vegetative segment inserted at or above the middle of the plant; ultimate subdivisions remote 57

57. Vegetative segment inserted near the middle of the plant: plant of dry woodlands .....
.....*Botrychium simplex laxifolium* Clausen.

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Botrychium simplex tenebrosum (A. A. Eaton) Clausen (included in *B. simplex* in Gray Man. 7ed.) G 48; W 29

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58. Vegetative segment inserted at some distance below the summit of the plant ....*Botrychium matricariaefolium* A Br. (*B. ramosum* in Gray Man. 7ed.) G 48; W 27

59. Plants stout and fleshy; subdivisions of vegetative segment 1-5 mm wide .....*Botrychium lanceolatum* (S. G. Gmel.) Angstrom. (Included in *G. l. angustisegmentum* in Gray Man. 7ed.) G 48; W 25

59. Plants lax and membranous; subdivisions of vegetative segment 1-2.5 mm wide ....*Botrychium lanceolatum angustisegmentum* Pease and Moore (See note above) G 48; W 25

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61. Sori not covered with an indusium; or indusium may drop when young 62

61. Sori covered with an indusium. (Forms in which the indusium drops when young may be sougbt either here or in tbe preceding subdivision of this step in the key.).. 70

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62. Fronds 1-4-pinnate 64

63. Fronds greyish, covered with peltate scales on ventral surface ....*Polypodium polypodioides michauxianum* Weatherby (Contr. Gray Herb. 124:31. 1939) G. 34; W 159

63. Fronds green, ventral surface not covered with peltate scales .....*Polypodium virginianum* L. (*P. vulgare* in Gray Man. 7ed.) G 34; W 159

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with a white waxy powder .....
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65. Rachis conspicuously winged between the pinnae 66

65. Rachis not winged between the pinnae 67

66. Frond longer than wide .....
....*Phegopteris polypodioides* Fee. G 35; W 151

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67. Frond not ternate, linear to lanceolate in outline 69

68. Fronds minutely glandular .....
....*Phegopteris robertiana* (Hoffm.) A. Br. G 35

68. Fronds not glandular .....
..*Phegopteris dryopteris* (L.) Fee. G 35; W 155

69. Stipe, rachis, and ventral side of the midvein of the pinnae minutely chaffy 127

69. Stipe, rachis, and ventral side of the midvein of the pinnae without conspicuous chaff 121

70. Indusium false, i. e. formed from the revolute margin of the frond 71

70. Indusium true, i. e. not formed from the revolute margin of the frond 89

71. Sori forming a more or less continuous marginal band... 72

71. Sori not forming a continuous marginal band 84

72. Stipe and rachis blackish or purplish 73

72. Stipe and rachis chestnut brown 76

72. Stipe and rachis straw-color or greenish..... 80

73. Stipe and rachis smooth, without scales 75

73 Stipe and rachis either rough or with scales or hoth 74

74. Upper surface of pinnules densely pubescent or tomentose or with numerous scales which are not limited to the midvein 76

74. Upper surface of pinnules entirely glabrous or with occasional scales on the midvein .....
....*Pellaea atropurpurea* (L.) Link. G 37; W 59

75. Lower surface of pinnules white and powdery .....
.....*Notholaena dealbata* (Pursh) Kuntze. G 35

75. Lower surface of pinnules not white and powdery ....*Pellaea glabella* Mett. W 61
76. Fronds woolly or tomentose 77
76. Fronds smooth or pubescent but neither woolly nor tomentose 78
77. Plants low; frond (blade plus stipe) 8-17 cm long; the first and second pair of pinnae conspicuously farther apart than the second and third pair ....*Cheilanthes feei* Moore. G 36
77. Plants taller; frond 1.5-5 dm long; the lowest two pairs of pinnae about the same distance apart as the second and third pair ....*Cheilanthes tomentosa* Link. G 36; W 65
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78. Fronds pubescent or hirsute 79
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80. Fronds ternate, not dimorphic; pinnules flat, not revolute 81
80. Fronds not ternate, strongly dimorphic; pinnules revolute forming pod-like structures 83
81. Pinnules densely woolly beneath.....*Pteridium aquilinum lanuginosum* (Bong.) Fern. Rhodora 37:247.
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83. Pinnules of fertile frond linear; those of vegetative frond ovate-oblong .....*Cryp-*

togramma crispa ocrostichoides (R. Br.) C. B. Clarke (*C. acrostichoides* in Gray Man. 7ed.) G 37

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84. Pinnules more or less revolute over the sori 76
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86. Rachis forked at the summit of the stipe 87
87. Primary subdivisions of the rachis 2, each bearing 3-10 or more pinnae 88
87. Primary subdivisions of the rachis 3, giving the frond a ternate aspect .....*Adiantum pedatum tripartitum* Farw. Amer. Fern Jour. 27:12. 1937
88. Sori markedly crescent-shape ....*Adiantum pedatum aleuticum* Rupr. Clute, Our Ferns p. 298. 1938
88. Sori not strongly crescent-shape ....*Adiantum pedatum* L. G 35; W 53
89. Fronds pellucid, i. e. clear and transparent, consisting of a single layer of cells ....*Trichomanes boschianum* Sturm. G 33
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90. Sori more or less elongated (at least slightly longer than wide), straight or curved 91
90. Sori more or less rounded, not confluent 120
90. Sori rounded when young, confluent when mature... 43
91. Veins reticulated, i. e. forming a network 92
91. Veins free, i. e. not forming a network (occasionally a few veins reticulated) 94
92. Sori parallel to the midvein of the pinnule, forming chain-like rows on either side of midvein 93
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93. Fronds pinnate .....*Anchistea virginica* (L.) Presl. (Woodwardia in Gray Man. 7ed.) G 38; W 117

93. Fronds pinnatifid .....*Lorinseria areolata* (L.) Presl. (Woodwardia in Gray Man. 7ed.) G 38; W 119

94. Sori confluent in pairs; frond entire or merely undulate 95

94. Sori not confluent in pairs; frond 1-pinnatifid to 4-pinnate 96

95. Sori occurring throughout most of the length of the frond ..*Phyllitis scolopendrium* (L.) Newman (*Scolopendrium vulgare* in Gray Man. 7ed.) G 40; W 115

95. Sori limited to the upper half of the frond.....*Phyllitis scolopendrium americana* Fern. Rhodora 37:220. 1935

96. Stipe black or purplish, or shining brown (not dull brown) 97

96. Stipe green, straw-color, or dull brown 105

97. Frond pinnatifid, or if pinnate, only so at base .....
.....*Asplenosorus ebenoides* (Scott) Wherry. (*Asplenium ebenoides* in Gray Man. 7ed.) G 38; W 111

97. Frond truly pinnate 98

98. At least the lower pinnae more or less auricled 99

98. Pinnae not auricled 104

99. Lower pinnae more or less pinnatifid 100

99. No pinnae pinnatifid 101

100. Margins of pinnae serrate or dentate.....
....*Asplenium bradleyi* D. C. Eaton. G 39; W 99

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101. Rachis green, different in color from stipe....*Asplenium kentuckiense* McCoy. Am. Fern Jour. 26:104. 1936

101. Rachis black and shining, same as stipe 102

102. Pinnae mostly opposite ..*Asplenium resilens* Kunze (*A. parvulum* in Gray Man. 7ed.) G 39; W 95

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103. Median pinnae 1-3 cm long; sori confluent in age .....
....*Asplenium platyneuron* (L.) Oakes. G 38; W 97

103. Median pinnae 5-8 cm long; sori not confluent in age....

.....*Asplenium platyneuron bacculum-rubrum* (Featherm) Fern. Rhodora 37:382. 1935; 38:304. 1936

104. Rachis black. *Asplenium trichomanes* L. G 38; W 93

104. Rachis green..X*Asplenium gravesii* Maxon. W 109

105. Frond (blade plus stipe) short, 3-25 cm long..... 106

105. Frond long, 4-15 dm long 110

106. Blade pinnatifid, or pinnate at base only..... 107

106. Blade 1-pinnate throughout .....
.....*Asplenium viride* Huds. G 38

106. Blade 2-4-pinnate 108

107. Blade pinnate in lower half, pinnatifid in upper half.....107a

107. Blade pinnatifid throughout, not at all pinnate.....
.....*Asplenium pinnatifidum* Nutt. G 38; W 107

107a. Lowermost pinnae mostly opposite .....
.....X *Asplenium trudellii* Wherry W 105

107a. Lowermost pinnae mostly alternate .....
.....*Asplenosorus inexpectatus* Braun (Braun, E. Lucy, Amer. Fern Jour. 29:133-135. 1939. Above name supplied in private correspondence by Miss Braun and here used for the first time.)

108. Stipe brown below, green above .....
.....*Asplenium montanum* Willd. G 39; W 103

108. Stipe green throughout 109

109. Pinnae lanceolate with incised margins and long attenuate tips .....*Asplenium cryptolepis ohianis* Fern. Rhodora 30:43. 1928

109. Pinnae narrowly cuneate to roundish-obovate, not at all attenuate .....
.....*Asplenium cryptolepis* Fern. G 39; W 101

110. Frond 1-pinnate .....*Diplazium pycnocarpon* (Spreng.) Broun (*Asplenium angustifolium* in Gray Man. 7ed.) G 39; W 85

110. Frond 2-pinnatifid .....*Diplazium thelypteroides* (Mx.) Presl. (*Asplenium acrostichoides* in Gray Man. 7ed.) G 39; W 87

110. Frond 2-4-pinnate 111

111. Fronds coriaceous 112

111. Fronds herbaceous, not coriaceous 113

112. Fronds 2-pinnate to somewhat 3-pinnatifid; ultimate subdivisions mostly approximate; sori median or

sub-median ..... *Athyrium alpestre* (Hoppe) Rylands. Rhodora 30:48. 1928

112 Fronds 3-pinnate to 4-pinnatifid; ultimate subdivisions distant; sori chiefly submarginal.. *Athyrium alpestre gaspense* Fern. Rhodora 30:48. 1928

113. Stipe very short, densely clothed with persistent scales; sori only slightly longer than wide ..... *Athyrium filixfaemina sitchense* Rupr. Moore, Index Filicum 183. 1860

113. Stipe 0.25 to 2 times the length of the blade; scales few and early deciduous; sori definitely longer than wide.. 114

114. Blade widest nearer the base than the middle; the second pair of pinnae only slightly shorter than the first pair ..... *Athyrium asplenioides* (Mx.) Eaton (*Asplenium filix-foemina* in Gray Man. 7ed.) G 40; W 91

114. Blade widest near the middle; the lowermost pinnae much shorter than the median 115

115. Sori at maturity confluent over the lower surface of the pinnule 116

115. Sori at maturity not confluent 118

116. Fertile pinnules deeply and sharply toothed, acute.. ..... *Athyrium angustum boreale* Jennings. Am. Fern Jour. 8:82. 1918

116. Fertile pinnules shallow-toothed, obtuse 117

117. Lowest pinnae of fertile frond 5-12 cm long; pinnules 4-12 mm long, simple ..... *Athyrium angustum* (Willd.) Presl. (*Asplenium filix-foemina* in Gray Man. 7ed.) G 41; W 89

117. Lowest pinnae of fertile frond 10-20 cm long; pinnules 12-25 mm long, pinnatifid..... *Athyrium angustum elatium* (Link) Butters. Rhodora 19:191. 1917

118. Pinnules lanceolate; membranous wing along rachis of pinnae obscure or wanting 119

118. Pinnules oblong; membranous wing along rachis of pinnae strongly developed.... *Athyrium angustum laurentianum* Butters. Rhodora 19:194. 1917

119. Indusia long-ciliate; pinnules sharply acute ..... *Athyrium angustum glanduliferum* Jennings. Am. Fern Jour. 8:82. 1918

119. Indusia obscurely ciliate; pinnules only subacute. . . . . *Athyrium angustum rubellum* (Gilb.) Butt. Rhodora 19:193. 1917
120. Indusia attached by one side 121
120. Indusia attached at 2 or more points beneath the sporangia, i. e. indusia inferior 126
120. Indusia attached by its center 133
121. Fronds ovate-lanceolate to oblong-lanceolate, 2-3-pinnate. . 122
121. Fronds deltoid-ovate, 3-4-pinnate. . . . *Cystopteris montana* (Lam.) Bernh. Underwood, Our Nat. Ferns 6ed. p119
122. Blade 1-3 dm long, not attenuate; pinnae decurrent on the winged rachis 123
122. Blade 3-8 dm long, attenuate: pinnae not decurrent on the wingless rachis; often bearing bulblets on back of rachis . . . . . *Cystopteris bulbifera* (L.) Bernh. G 43; W 79
123. Basal pinnules of lower pinnae sessile 124
123. Basal pinnules of lower pinnae with a definite margined petiolule . . . . . *Cystopteris fragilis protrusa* Weatherby. W 77
124. Basal pinnules of lower pinnae unevenly cuneate at base, from nearly orbicular to deltoid-lanceolate; indusium relatively large, up to 1 mm long, more or less deeply cleft at apex 125
124. Basal pinnules of lower pinnae evenly cuneate at base, oblong to obovate, or lanceolate to oblong-lanceolate; indusium about 0.5 mm long, shallowly lobed or nearly entire . . . . . *Cystopteris fragilis mackayii* Lawson. W. 75
125. Plant about 2.5 dm high; indusium glabrous . . . . . *Cystopteris fragilis* (L.) Bernh. G 43; W 75
125. Plant larger, up to 5 dm high; indusium sparsely and minutely glandular on the back . . . . . *Cystopteris fragilis laurentianum* Weatherby. Rhodora 37. 375. 1937
126. Indusium cup-shape, its margin only shallowly cut. . . . . *Dennstaedtia punctilobula* (Mx.) Moore (Dicksonia in Gray Man. 7ed.) G 44; W 49
126. Indusium cut into numerous narrow segments. 127
127. Stipe obscurely articulated some distance above the base (observed as a dark irregular ring encircling the stipe). 128

127. Stipe not articulated 130
128. Stipe and ventral surface of blade densely rusty-chaffy .....
.....*Woodsia ilvensis* (L.) R. Br. G 44; W 69
128. Stipe and ventral surface of blade not densely rusty-chaffy, glabrous or nearly so 129
129. Blades oblong-lanceolate, 16-24 mm wide .....
.....*Woodsia alpina* (Bolton) S. F. Gray. G 44
129. Blades linear, 8-16 mm wide .....
.....*Woodsia glabella* R. Br. G 44
130. Blade minutely glandular-puberulent 131
130. Blade entirely glabrous .....
.....*Woodsia oregana* D. C. Eaton. G 44
131. Blade 2-pinnate to 3-pinnatifid .....
.....*Woodsia obtusa* (Spreng.) Torr. G 44; W 71
131. Blade 1-pinnate to 2-pinnatifid 132
132. Blade loosely hispidulous with jointed white hairs..
....*Woodsia scopulina* D. C. Eaton. G 44; W 73
132. Blade not hispidulous .....
.....*Woodsia cathcartiana* Robinson. G 44
133. Indusium round, without a sinus 43
133. Indusium round or reniform, with a sinus..... 134
134. Lowest veins on each pinnule simple or once-forked. 135
134. Lowest veins more than once-forked 137
135. Lower pinnae gradually decreasing in size until the lowest are very small .....
..*Dryopteris noveboracensis* (L.) Gray (Aspidium in Gray Man. 7ed.; Thelypteris in Wherry) G 41; W 149
135. Lower pinnae equal or somewhat smaller than the median but not becoming less than ½ the length of the median 136
136. Fruiting veins simple .....
.....*Dryopteris simulata* Davenp. (Aspidium in Gray Man.; Thelypteris in Wherry) G 41; W 147
136. Fruiting veins once-forked .....*Dryopteris thelypteris pubescens* (Laws.) Prince (Aspidium in Gray Man.; Thelypteris in Wherry) G 41; W 145
137. Pinnae 40-60, very small, 4-8 mm broad 138
137. Pinnae fewer, larger, 1.2-9 cm broad 139
138. Pinnules crowded, lower surface of blade covered

with scales ..... *Dryopteris fragrans* (L.) Schott (Aspidium in Gray Man. 7ed.) G 42

138. Pinnules subremote, lower surface of blade sparsely scaly ..... *Dryopteris fragrans remotiuscula* Komarov. Rhodora 25:3. 1923

139. Sori marginal..... *Dryopteris marginalis* (L.) Gray (Aspidium in Gray Man. 7ed.) G. 42; W 131

139. Sori not marginal 140

140. Basal scales lance-linear, caudate-attenuate..... ..... *Dryopteris filix-mas* (L.) Schott (Aspidium in Gray Man. 7ed.). G 42

140. Basal scales lance-oblong, ovate-oblong, or deltoid, not attenuate 141

141. Basal scales thick and firm, deep chestnut-brown .... *Dryopteris goldianum* (Hook.) Gray. (Aspidium in Gray Man. 7ed.) G 42; W 133

141. Basal scales thin, membranous, light-brown 142

142. Blades 2-pinnatifid to 2-pinnate 143

142. Blades 3-pinnatifid to 4-pinnate 148

143. Indusium glandular-puberulent 144

143. Indusium not glandular-puberulent 146

144. Marginal teeth of pinnules spreading; sori about 1.2 mm in diameter .... *Dryopteris bootii* (Tucerm.) Underw. (Aspidium in Gray Man. 7ed.) G 42; W 139

144. Marginal teeth of pinnules incurved; sori 1.5-1.8 mm in diameter 145

145. Sori near the midvein..... *Dryopteris clintoniana* (D. C. Eaton) Dowell. (*Aspidium cristatum clintonianum* in Gray Man. 7ed.) G 42; W 135

145. Sori about half-way between midvein and margin..... ....*Dryopteris clintoniana australis* Wherry. W 135

146. Blade conspicuously narrowed at the base..... ..... *Dryopteris cristata* (L.) Gray (Aspidium in Gray Man. 7ed.) G 42; W 137

146. Blade scarcely or not at all narrowed at base..... 147

147. Lobes of pinnules incurved-serrate 145

147. Lobes of pinnules spinulose-dentate 148

148. The first pair of pinnules on the upper and lower

sides of the lowermost pinnae nearly opposite, rarely more than 4 mm apart 149

148. The first pair of pinnules on the upper and lower sides of the lowermost pinnae 0.5-2 cm apart, the pinnule on the lower side farthest from the rachis and usually exceeding the pinnule next to it 151

149. Midrib of pinnae not glandular; indusia not glandular; the first pinnule on the lower side of the lowermost pinnae longer than the one next to it ....*Dryopteris spinulosa* (Mueller) Watt. (Aspidium in Gray Man. 7ed.) G 43; W 127

149. Midrib of pinnae glandular near their bases; indusia glandular; the first pinnule on the lower side of the lowermost pinnae not longer than the one next to it... 150

150. Pinnae tending to be set at right angles to the rachis and to taper abruptly to a long narrow point.... ..... *Dryopteris intermedia* (Muhl.) Gray (*Aspidium spinulosum intermedium* in Gray Man. 7ed.) G 43; W 125

150. Rachis of pinnae forming an acute angle with the primary rachis of the blade, pinnae not abruptly narrowed at their tips .....*Dryopteris intermedia fructuosa* (Gilbert) Wherry. W 125

151. Blade 4-pinnatifid below; pinnules of the second order on the lower side of the lowermost pinnae about twice as long as those on the upper side of the same pinnae; indusium glabrous or sparsely glandular ....*Dryopteris campyloptera* (Kunze) Clarkson. W 129

151. Blade 3-pinnate; pinnules not as above; indusium glandular (known only from Concord, Mass., and York Co., Pa.) ....*Dryopteris intermedia concordiana* (*Aspidium spinulosum concordiana* in Gray Man. 7ed.) G 43

152. Vegetative and fertile stems conspicuously unlike... 153

152. Vegetative and fertile stems essentially similar in appearance 157

153. Vegetative branches simple 154

153. Vegetative branches compound 156

154. Vegetative branches 1-1.5 mm wide; sheaths of vege-

tative branches 4-toothed 155

154. Vegetative branches 0.3-0.6 mm wide; sheaths 3-toothed .....
.....*Equisetum pratense* Ehrh. G 52; W 209

155. Vegetative branches spreading; teeth of sheaths on vegetative branches green or greyish .....
.....*Equisetum arvense* L. G 52; W 211

155. Vegetative branches ascending or erect; teeth of sheaths blackish .....*Equisetum arvense boreale* (Bong) Rupr. Fern Bull. 7:86. 1899

156. Vegetative branches rough to the touch.....
.....*Equisetum sylvaticum* L. G 52; W 207

156. Vegetative branches smooth to the touch.....
.....*Equisetum sylvaticum pauciramosum* Milde. Rhodora 20:131. 1918

157. Cone or strobilus not tipped with a rigid point..... 158

157. Cone or strobilus tipped with a rigid point 160

158. Erect stems unbranched.....*Equisetum kansanum* Schaffner. Ohio Nat. 13:21. 1912.

158. Erect stems branched 159

159. Sheaths appressed; teeth of sheaths 18, dark brown.....
.....*Equisetum fluviatile* L. G 53; W 203

159. Sheaths loose; teeth 8, with white margins .....
.....*Equisetum palustre americana* Vict. (*E. palustre* in Gray Man.) G 52; W 205

160. Aerial stems tall and many-grooved 161

160. Aerial stems low, tufted, 5-10-grooved..... 163

161. Stems rough and tuberculate 162

161. Stems not tuberculate .....
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162. Ridges of stem 40 or more .....
.....*Equisetum prealtum* Raf. (Included in *E. hyemale* in Gray Man. 7ed.) G 53; W 197

162. Ridges of stem less than 40 .....
.....*Equisetum prealtum affine* (Engelm.) Broun (*E. h. affine* in Gray Man.) G 53

163. Sheaths 3-toothed.....*Equisetum scirpoides* Mx. G 54

163. Sheaths 5-10-toothed 164

164. Awn-pointed tips of sheaths deciduous 165

164. Awn-pointed tips of sheath-teeth persistent .....

.....*Equisetum trachydon* A. Br. (*E. variegatum jesupi* in Gray Man. 7ed.) G 54

165. Ridges of internodes 2-angled with a broad central groove and a double row of tubercles; sheath segments grooved through the base .....*Equisetum variegatum* Schleich. G 54; W 201

165. Ridges rounded; sheath segments grooved only at the upper end, the base rounded .....*Equisetum nelsoni* (A. A. Eaton) Schaffner (*E. v. nelsoni* in Gray Man. 7ed.) G 54

166. Leaves without either bast bundles or stomata; plants permanently submersed 167

166. Leaves without bast bundles but with stomata; plants partially submersed 170

166. Leaves with both bast bundles and stomata; plants emersed most of the growing season 173

167. Leaves stout, rigid, erect 168

167. Leaves slender, mostly recurved 169

168. Macrospores honeycomb-reticulated below...*Isoetes macrospora* Durieu (*I. hieroglyphica* and *I tuckermanni harveyi* in Gray Man. 7ed.) G 59; W 193

168. Macrospores with distinct or anastomosing crests... *Isoetes macrospora heterospora* A. A. Eaton. G 59

169. Leaves about 1 mm in diameter .....*Isoetes tuckermanni* A. Br. G 59

169. Leaves about 3 mm in diameter .....*Isoetes macrospora* Durieu. G 59; W 193

170. Leaves green 171

170. Leaves reddish or rarely olive-green..... 172

171. Macrospores armed with spines .....*Isoetes braunii* Durieu (I. echinospora braunii and I. e. muricata in Gray Man. 7ed.) G 60; W 193

171. Macrospores crested or warted but without spines..... .....*Isoetes riparia* Engelm. G 60; W 195

172. Macrospores averaging 410 microns in diameter; wall with small pits .....*Isoetes foveolata* A. A. Eaton. G 60

172. Macrospores averaging 510 microns in diameter; wall thin and irregular .....*Isoetes foveolata plenospora* A. A. Eaton. G 60

173. Leaves setaceous, plants of dry situations, rarely near water's edge ..... *Isoetes butleri* Engelm. G 61

173. Leaves not setaceous; plants growing in water 174

174. Leaves over 3 dm long; macrospores with longitudinally folded ridges ..... *Isoetes eatoni* Dodge. G 60; W 193

174. Leaves less than 3 dm long; macrospores not as above 175

175. Primary bast bundles 4, extra bundles near periphery of leaf ..... *Isoetes melanopoda* Gay & Durieu. G 61; W 195

175. Bast bundles 4, without extras 176

176. Macrospores coarsely crested ..... *Isoetes riparia canadensis* Engelm. (*I. dodgei* and *I. d. robbinsii* in Gray Man. 7ed.) G 61; W 193

176. Macrospores merely reticulated ..... *Isoetes engelmanni* A. Br. G 61; W 191

176. Macrospores covered with short truncate single columns..... *Isoetes gravesii* A. A. Eaton. G 61